

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A computer-implemented method for updating a process recipe in a CMP process for a multilayer wafer, comprising the steps of:
 - (a) inputting a model for defining CMP processing of a wafer having at least first and second dielectric layers comprising at least one control parameter, said model comprising a first component that predicts a value for a characteristic of the first dielectric layer and a second component that predicts a value for a characteristic of the second dielectric layer;
 - (b) determining a process recipe for processing at least first and second dielectric layers of a wafer based upon the model of step (a);
 - (c) receiving a first measured value of the characteristic of the first dielectric layer and/or a second measured value of the characteristic of the second dielectric layer for a wafer processed according to the process recipe of step (b);
 - (d) updating the first and second component based upon the difference between the measured values and the predicted values of the characteristics of the first and second dielectric layers to obtain an updated model~~determining an updated model based upon the difference between the measured value and the predicted value of the characteristic;~~ and
 - (e) calculating an updated process recipe for use in processing a subsequent wafer based upon the updated model of step (d).
2. (Original) The method of claim 1, wherein the model determines a first process recipe for the first layer of the wafer and a second process recipe for the second layer of the wafer.
3. (Original) The method of claim 1, wherein the model is defined as:

$$Y_t = Y_A + Y_B,$$

where

Y_t is the model for a CMP process for a multi-layer wafer;
 Y_A is the model for a CMP process for the first layer of the wafer; and
 Y_B is the model for a CMP process for the second layer of the wafer.

4. (Original) The method of claim 1, wherein the characteristic of the first and second layers of the wafer comprises film thickness, and/or the control parameter comprises polishing time.
5. (Original) The method of claim 1, wherein the model of step (a) defines a plurality of regions on a wafer and a measured value for the wafer characteristic for each of the plurality of regions is received in step (c).
6. (Original) The method of claim 1, wherein the processing recipe comprises a plurality of polishing steps.
7. (Original) The method of claim 1, wherein the model accounts for a tool state of a tool used in the CMP processing of a wafer.
8. (Original) The method of claim 1, further comprising developing a model, said model development comprising the steps of
 - (e) inputting pre-polished wafer characteristics for one or more wafers;
 - (f) receiving measured values of the wafer characteristics for the one or more wafers processed according to a processing recipe;
 - (g) providing a model defining the effect of tool state on polishing effectiveness;and
 - (h) recording the pre-polished and post-polished wafer characteristic on a recordable medium.
9. (Original) The method of claim 8, wherein model development further comprises fitting the data to a curve that establishes a relationship between the wafer characteristic and the control parameter.
10. (Currently Amended) A method of controlling a characteristic of a wafer in a CMP operation, comprising the steps of:
 - (a) providing a model for CMP processing of a wafer having at least first and second layers comprising at least one control parameter capable of being controlled, comprising a first component that predicts a value for a characteristic of the first layer and a second component that predicts a value for a characteristic of the second layer;

(b) polishing at least first and second layers of a wafer using a ~~first~~ polishing recipe based upon the model of step (a);

(c) measuring the wafer characteristic for a wafer processed according to the process recipe of step (b); and

(d) determining an updated model based upon the difference between the measured value and the predicted value of the wafer characteristic; and

(e) calculating an updated process recipe for use in processing a subsequent wafer based upon the updated model of step (d).

11. (Original) The method of claim 10, further comprising:

determining an updated process recipe based upon the updated model of step (d).

12. (Original) The method of claim 10, wherein the model determines a first process recipe for the first layer of the wafer and a second process recipe for the second layer of the wafer.

13. (Original) The method of claim 10, wherein the model accounts for the tool state of a tool used in the CMP processing of a wafer.

14. (Original) The method of claim 10, wherein the model is defined as:

$$Y_t = Y_A + Y_B,$$

where

Y_t is the model for a CMP process for a multi-layer wafer;

Y_A is the model for a CMP process for the first layer of the wafer; and

Y_B is the model for a CMP process for the second layer of the wafer.

15. (Original) The method of claim 10, wherein the characteristic of the first and second layers of the wafer comprises film thickness, and/or the control parameter comprises polishing time.

16. (Original) The method of claim 10, wherein the model defines a plurality of regions on a wafer and identifies a wafer material removal rate in a polishing step of a polishing process for each of the regions.

17. (Original) The method of claim 10, wherein the polishing process comprises a plurality of polishing steps.
18. (Original) The method of claim 16, wherein the plurality of regions in the model of step (a) comprises regions extending radially outward from a center point on the wafer.
19. (Original) The method of claim 10, wherein the polishing of step (b) comprises polishing the wafer at a plurality of polishing stations.
20. (Original) The method of claim 19, wherein determining the updated polishing model of step (d) comprises calculating updated models for each of the plurality of polishing stations.
21. (Original) The method of claim 20, wherein the updated polishing model for each of the plurality of polishing stations accounts for the tool state of the individual polishing stations.
22. (Original) The method of claim 19, wherein, the initial wafer thickness for each of the polishing stations is provided by the prediction from previous polishing stations.
23. (Currently Amended) An apparatus for polishing a wafer in a CMP operation having controlled characteristics, comprising:
 - (a) a model for comprising at least one control parameter capable of being controlled for CMP processing of a wafer having at least first and second layers, comprising a first component that predicts a value for a characteristic of the first layer and a second component that predicts a value for a characteristic of the second layer;
 - (b) polishing means for polishing at least first and second layers of a wafer using a ~~first~~ polishing recipe based upon the model of step (a);
 - (c) measuring means for measuring the wafer characteristic for a wafer processed according to the process recipe of step (b); and
 - (d) calculating means for determining an updated model based upon the difference between the measured value and the predicted value of the wafer characteristic; and
 - (e) calculating means for updating a process recipe for use in processing a subsequent wafer based upon the updated model of step (d).

24. (Original) The apparatus of claim 23, wherein the model defines a first process recipe for the first layer of the wafer and a second process recipe for the second layer of the wafer.
25. (Original) The apparatus of claim 23, wherein the model accounts for the tool state of a tool used in the CMP processing of a wafer.
26. (Original) The apparatus of claim 23, wherein the characteristic of the first and second layers of the wafer comprises film thickness, and/or the control parameter comprises polishing time.
27. (Original) The apparatus of claim 23, wherein the model defines a plurality of regions on a wafer and identifies a wafer material removal rate in a polishing step of a polishing process for each of the regions.
28. (Original) The apparatus of claim 27, wherein the polishing process comprises a plurality of polishing steps.
29. (Original) The apparatus of claim 23, wherein the polishing of step (b) comprises polishing the wafer at a plurality of polishing stations.
30. (Currently Amended) ~~An~~ A system for polishing a wafer in a CMP operation having controlled characteristics, comprising:
- (a) a model for comprising at least one control parameter capable of being controlled for CMP processing of a wafer having at least first and second layers, comprising a first component that predicts a value for a characteristic of the first layer and a second component that predicts a value for a characteristic of the second layer;
 - (b) CMP polishing station for polishing at least first and second layers of a wafer using ~~a first~~ the polishing recipe based upon the model of step (a);
 - (c) a metrology tool for measuring the wafer characteristic for a wafer processed according to the process recipe of step (b); and
 - (d) a computer for calculating an updated model based upon the difference between the measured value and the predicted value of the wafer characteristic and an updated process recipe for use in processing a subsequent wafer based upon the updated model.